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Fertilizers for Field Crops, 1955

WILLIAM L. GARMAN

The fertilizer recommendations in this bulletin are directed toward more efficient production of higher yielding crops; they are based on the results from replicated experiments from widely separated areas and on different soil types in the State.

The Fertilizer Situation

The United States Department of Agriculture predicts a 5 per cent increase in the supply of plant nutrients for 1955. Prices are expected to be about the same as last year or slightly below. The trend continues toward the use of fertilizers of higher analyses with a greater proportion being granulated.

Some of of the newer, straight-nitrogen materials, such as **anhydrous ammonia, solution 2,** and **urea,** will be more widely available and in some cases at a lower price than in previous years.

Fertilizer Bargain

Fertilizer and lime are still the biggest bargains on the farm. Of all the commodities used — fertilizer, feed, seed, machinery and so forth — the cost of fertilizer has increased the least. Compare the figures in table 1.

Fertilizer, one of the most important items in lowering the cost of crop production per acre, is still the "best buy" on the farm.

Table 1. Increase in Farm Production Supplies

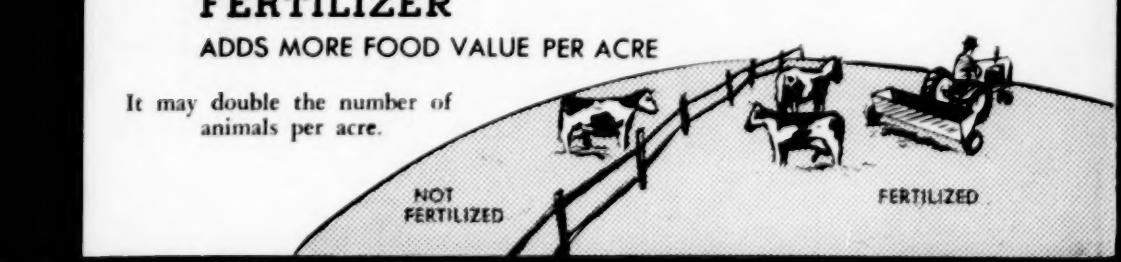
Farm Production Supplies	Percentage Increase over 1935 Prices
Fertilizer	51
Seed	95
Machinery	110
Feed	114
Motor vehicles	140
Building and fencing materials	144

Plant Nutrients in Soil

Plants require twelve mineral elements for healthy growth: nitrogen, phosphorus, potassium, calcium, magnesium, iron, sulfur, manganese, boron, zinc, copper, and molybdenum.

Since nitrogen, phosphorus, and potassium are needed in largest amounts, they are the elements most frequently deficient in soils and are the essential ingredients bought in a bag of complete fertilizer.

The amount of the three major plant nutrients removed by impor-



Superphosphate applied with the manure is held in more available form than if applied directly to the soil.

Where the phosphorus level of the soil has been maintained by moderate fertilization, 1 pound of superphosphate per cow per day is enough.

Soil Testing

Complete soil tests for pH, total organic matter, and available phosphorus, potassium, and magnesium are available through local county agricultural agents, who have containers and instructions for taking the samples. The county agent sends the samples to the Soil Testing Laboratory of the Department of Agronomy at Cornell. He also makes recommendations for fertilizer use and soil management after receiving the results of the tests from the laboratory.

Leaf Feeding of Plant Nutrients

Occasionally extravigant claims have been made as to the merits of foliar application of small quantities of soluble fertilizers.

Up to the present time, no nutrient spray program using complete fertilizers has proved to be economically sound for field crop production. Even with frequent spraying of the foliage of vegetables, it has not been possible to supply the plants' needs without the application of fertilizers to the soil. **Nothing is miraculous about leaf feeding!**

FERTILIZERS FOR FIELD CROPS, 1955

Ratio: Refers to the balance or relative amount of nitrogen (**N**) to phosphorus (P_2O_5) to potassium (K_2O) in a mixed fertilizer. A 1-1-1 ratio, has the same relative amounts of these three plant foods, but a 1-2-1 ratio has twice as much phosphorus as either nitrogen or potash.

Analysis or Grade: Refers to the actual guaranteed composition of the fertilizer. A 1-1-1 ratio may therefore be available in several grades, such as 12-12-12, 10-10-10, or 7-7-7. Likewise a 1-2-2 ratio may be purchased as 5-10-10 or 8-16-16.

The high-analysis grades are usually the better buy since savings are made in the transportation and handling of the more concentrated materials. They cost more per ton but less per pound of nutrients.

The high-analysis grades are listed for each crop in the large table but equivalent amounts of the lower analysis grades of the same ratio can be determined from the small table below.

Consult Your Local Dealer for the "Best Buy" Grade Available.

Ratios $N-P_2O_5-K_2O$	*Grades*		*If alternate is used, multiply amount in table by:*
	First Choice $N-P_2O_5-K_2O$	*Alternate*	
1-1-1	10-10-10, 12-12-12, 13-13-13	7-7-7	1.4

Table 2. Plant Nutrients Removed by Crops

Crops	Nitrogen as N	Phosphorus as P_2O_5	Potassium as K_2O
		Pounds	
Oats, 60 bushels	38	15	10
Wheat, 40 bushels	48	20	14
Corn (ear), 100 bushels	90	36	26
Timothy hay, 1.5 tons	30	12	54
Clover hay, 2 tons	80	18	70
Alfalfa hay, 4 tons	180	40	180
Corn (silage), 20 tons	150	60	144

tant field crops in New York is shown in table 2.

Very few New York soils can furnish the amounts of N, P_2O_5, and K_2O that are needed to produce the yields shown in table 2. Actually many soils can furnish no more than one-half enough of these nutrients. Therefore, from 25 to 50 per cent of the large yields made on many farms may be attributed to the use of fertilizer.

Lesser amounts of calcium, magnesium, iron, and sulfur are needed, as well as trace elements or the so-called minor elements (manganese, boron, zinc, copper, and molybdenum).

Mineral elements are really part of the raw materials from which plants build up our foods. Oxygen and hydrogen from water and carbon from carbon dioxide in the air are the other raw materials. Plants use the energy from the sunlight to build these raw materials into organic compounds, such as sugar, starch, oil, and protein.

NITROGEN is vital to crops because it:

- Promotes rapid vegetative growth
- Improves quality of leafy crops
- promotes fruit or seed growth
- Results in increased yields
- Increases protein content

New York soils contain about 3000 pounds of total nitrogen, most of which is in the organic matter and is unavailable to plants until decayed by bacteria. Thus, only from 2 to 4 per cent (60 to 120 pounds) becomes available each year to growing crops. Those crops that need more than this amount or those that grow during cold and wet seasons when soil bacteria are not functioning must have additional supplies of nitrogen in the form of commercial fertilizers.

Corn, for example, needs more nitrogen than the soil can supply, and wheat grows during the cool part of the year when the soil bacteria do not release nitrogen rapidly enough to make big yields. For this reason, spring top-dressing wheat with nitrogen has consistently increased yields. In 23 farm trials, 30 pounds of nitrogen top-dressed on wheat in early spring gave an increase of 6.8 bushels an acre. The value of the extra wheat above the cost of the nitrogen was $9.60 an acre.

Stiff-strawed varieties of oats (Mohawk, Clinton, and Craig) likewise gave profitable increases from nitrogen applied in commercial fertilizers.

Top-dressing timothy or bromegrass meadows, where the legume has run out, with 50 pounds of nitrogen per acre has consistently increased the yield of hay from ½ to 1 ton

crop				150 lbs. 45% superphosphate	For soils with no indication of high potash requirement.
8. SUDAN GRASS Seeded	Manured	1–1–1	20–20–20	8 T. phosphated manure plus 200 lbs. 10–10–10	Top-dress seeding later. See Crop 9.
	Not manured	1–2–1	30–60–30	375 lbs. 8–16–8	Use 1–2–2 ratio where extra potash is needed. Top-dress seeding later. See Crop 9.
		1–2–2	30–60–60	375 lbs. 8–16–16	
Sudan or millet (not seeded)		1–1–1	40–40–40	400 lbs. 10–10–10	Where not used as companion crop for forage seeding.
9. ALFALFA *or* LADINO CLOVER *or* BIRDSFOOT TREFOIL (topdress)	Manured			6 T. phosphated manure	Apply manure every other year. Use 0–1–0, 0–1–2, or 0–1–1 ratio fertilizer the alternate year depending on soil test.
	Not manured: High potash need* (for high production on gravels, sands, and some silt loams)	0–1–2	0–30–60	200 lbs. 0–15–30	Best on very low potash soils where soil phosphorus is medium to high. For best efficiency, apply after first cutting of hay, or after flush of spring grazing.
		0–1–1	0–60–60	300 lbs. 0–20–20	For soils low in both phosphorus and potash or where very large yields are removed. May be alternated with manure or 0–1–2.
	Moderate potash need*	0–1–1	0–40–40	200 lbs. 0–20–20	Where some potash is needed on loams and slightly heavier soils.
	Low potash need*	0–1–0	0–100–0	500 lbs. 20% or 225 lbs. 45% superphosphate	For soils that have a high potash supplying power (clays, heavy loams) or where unphosphated manure is used. Repeat after 3 years.
10. GRASS MEADOW (topdress)	Manured			6 T. manure	Apply manure or 10–10–10 every other year and straight nitrogen fertilizer in the year between. On heavy soils, nitrogen alone may be needed. If legume disappears from orchard grass pasture, use up to 200 lbs. straight nitrogen in 3 or 4 applications.
	Not manured	1–1–1 or 1–0–0	50–50–50 50–0–0	500 lbs. 10–10–10 or 50 lbs. of straight nitrogen	
11. NATIVE PASTURE	Without legumes	1–1–1	40–40–40	400 lbs. 10–10–10	6 tons phosphated manure may be substituted and spread 2 months before spring grazing.
	With legumes	0–1–1	0–40–40	200 lbs. 0–20–20	Apply after flush of spring growth on light textured soils.
		0–1–0	0–100–0	500 lbs. 20% or 225 lbs. 45% superphosphate	Use where potash is not a problem on heavy loams and clays.
12. BUCKWHEAT		1–2–1	15–30–15	200 lbs. 8–16–8	
13. SOYBEANS		1–2–2	15–30–30	200 lbs. 8–16–16	

*Three useful guides to the potash status of a field:

1. Sands and gravels are naturally lower in potash than heavier textured loams, silt loams, and clay loams. There are, however, differences in soils of the same surface texture in the rate at which they supply potash.
2. Heavy applications of manure or high potash fertilizers build a temporary potash reserve.
3. A soil test is becoming more valuable as a guide on very low or very high potash soils. Check with your county agricultural agent.

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Composition of Un-mixed Fertilizer Materials: Nitrogen	Phosphorus	0–1–2	0–15–30	0–12–24	1.2

Composition of Un-mixed Fertilizer Materials:

Nitrogen		Phosphorus	
Ammonium Nitrate	33.5% N	Superphosphate	18–20% P_2O_5
Ammonium Sulfate	20.5% N	Triple-Superphosphate	45% P_2O_5
Ammonium Nitrate Limestone (ANL)	20.5% N		
Calcium Cyanamid	21% N		
Sodium Nitrate	16% N		
Urea	40–46% N	**Potash**	
Nitrogen Solution 2	40.6% N	Muriate of Potash	60% K_2O
Anhydrous Ammonia	82% N		

0–1–2	0–15–30	0–12–24	1.2

Fertilize the Rotation: These fertilizer recommendations are given for each individual crop. The fertility program for a field can best be planned on the basis of the whole rotation, because a large amount of fertilizer applied to one crop influences the kind and amount that is needed for the crops that follow.

Phosphated Manure: Some farmers use 2 pounds of superphosphate on the stable floor per cow each day. Soil tests show that farmers who have followed this practice for many years, together with liberal fertilization at planting time, have accumulated a high phosphorus reserve in some fields. It is more economical for these farmers to shift to 1 pound of superphosphate.

Crop	Situation	Recommended Nutrients		Suggested Analysis and Application	Special Suggestions	
		Ratio	Lbs. per acre			
		$N–P_2O_5–K_2O$	$N–P_2O_5–K_2O$	Amount per acre		
1. CORN	Manure or a good legume sod, plowed down	1–1–1	20–20–20	10 T. phosphated manure plus 200 lbs. 10–10–10	Fertilize in the row at planting time or use 125 pounds of 8–16–16 at planting plus 20 to 30 pounds of nitrogen as a side-dressing.	
	No manure, no legume sod	1–1–1 and 1–0–0	40–40–40 plus 30–0–0	400 lbs. 10–10–10 and 30 lbs. of straight nitrogen	Row fertilize at planting time. There may be danger of fertilizer "burn" at this or higher rates if the fertilizer is placed **in contact with** seed. **Top-dress** grass sod before plowing or **side-dress** corn when 12 to 18 inches tall. Side-dressing most needed if heavy rains after planting leach the nitrogen.	
2. OATS *or* **BARLEY seeded to a forage mixture**	Not likely to lodge: High potash soils*	1–2–1	35–70–35	440 lbs. 8–16–8	Mohawk, Clinton, Craig oats or Moore barley	Top-dress seedings in following years as outlined under Crop 9.
			20–40–20	250 lbs. 8–16–8	For weak-strawed varieties.	
	Medium to low potash soils*	1–2–2	35–70–70	440 lbs. 8–16–16	Mohawk, Clinton, Craig oats or Moore barley	
			20–40–40	250 lbs. 8–16–16	For weak-strawed varieties.	
	Where grain may lodge: High potash soils*	0–1–0	0–60–0	300 lbs. of 20% or 150 lbs. 45% superphosphate	While lodging is still a problem on some heavily manured fields (especially valley farms), farmers are generally urged to use nitrogen on the stiff-strawed varieties.	
	Medium to low potash soils*	0–1–1	0–60–60	300 lbs. 0–20–20	Top-dress seedings in later years as outlined under Crop 9.	
3. OATS *or* **BARLEY not seeded**		1–1–1	35–35–35	350 lbs. 10–10–10	Mohawk, Clinton, Craig oats or Moore barley	Omit fertilizer if grain is likely to lodge.
			20–20–20	200 lbs. 10–10–10	Weak-strawed varieties.	
4. WHEAT *or* **WINTER BARLEY**		1–2–1 and 1–0–0	20–40–20 plus 30–0–0	250 lbs. 8–16–8 and 30 lbs. straight nitrogen	At planting time top-dress in spring or use 6 tons phosphated manure if seeded.	Fertilize forage seeding as in following years outlined under Crop 9 if seeded.
5. RYE		1–2–1	20–40–20	250 lbs. 8–16–8	If seeded, fertilize forage crop later as outlined in Crop 9.	
6. ALFALFA— (summer seeded) No companion crop	High potash soils*	0–1–0	0–60–0	300 lbs. 20% or 150 lbs. 45% superphosphate	Apply at planting time.	
	Extra potash needed*	0–1–1	0–60–60	300 lbs. 0–20–20	Top-dress seeding later. See Crop 9.	
	Generally low fertility	1–2–2	30–60–60	375 lbs. 8–16–16	Band-seeding may have particular application here to improve establishment.	
7. BIRDSFOOT TREFOIL seeded without a companion	Soils low in nitrogen (old grass sods)	1–2–1	30–60–30	375 lbs. 8–16–8	Band seeding may have special advantage here because of the low fertility.	
	Soils with medium to high nitrogen	0–1–1	0–60–60	300 lbs. 0–20–20	For soils low in potash not receiving manure.	
		0–1–0	0–60–0	300 lbs. 20% or		

an acre. Where more hay is needed, this is one of the most economical ways to get it.

PHOSPHORUS is indispensible to crops because it:

- Stimulates early growth and root formation
- Promotes seed production
- Gives hardiness to plants
- Is necessary for protein formation

Liming acid soils reduces the "**fixation**" of the available phosphorus applied as commercial fertilizer. The "**easily available**" calcium and ammonium phosphates present in the fertilizer bag are rapidly converted into unavailable iron and aluminum phosphates when applied to acid soils at pH values less than 6.0.

Liming the soil to a pH of 6.0 or higher greatly reduces this phosphate fixation; it also increases the release of phosphorus from the soil organic matter.

POTASH is a requirement for high yields because it:

- Helps to form starch
- Produces strong stalks
- Imparts disease resistance
- Increases plumpness of grain

As yield per acre of crops increases, the necessity for a fertilizer relatively high in potash (1-2-2, 1-1-1, 0-1-1, or 0-1-2 ratio), becomes more important, particularly on sandy and gravelly soils.

Soils differ considerably in their power to supply potash. Complete soil tests are most helpful to determine the availability of this nutrient.

SECONDARY OR MINOR ELEMENTS

Most New York soils supply enough boron, magnesium, manganese, copper, sulfur, iron, zinc, and molybdenum for field crops.

Boron deficiency has been observed on some legume crops during the dry seasons. The characteristic yellowing of the tops of alfalfa plants (symptom of boron deficiency) has been prevented by a top-dressing of 25 pounds of borax an acre, but economically significant yield increases have not been obtained because moisture limited growth more than did a deficiency of boron.

Magnesium availability on many acid soils as shown by soil tests has been very low; often as low as 5 to 10 pounds an acre. Experimental applications of magnesium on such soils have not given consistent increases in the production of field crops. Where, however, soil tests indicate that the magnesium supply on acid soils is low, it would be considered wise to apply a high magnesium or dolomitic limestone. Practically none of the high-lime soils have been found to be deficient in magnesium.

SUPERPHOSPHATE MANURE

The use of superphosphate in the stable:

- Balances the nutrients
- Absorbs and holds nitrogen
- Absorbs moisture and reduces slipperiness

Manure is notably low in phosphorus, and the addition of superphosphate makes it a better balanced fertilizer.

(continued on the center spread)